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Interactive comment on "Automatic high-frequency measurements of full soil greenhouse gas fluxes in a tropical forest" *by* Elodie Alice Courtois et al.

N. Liang

liang@nies.go.jp

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This manuscript focused on a very important topic about soil CO2/CH4/N2O fluxes in tropical rainforest. The experiment was well designed. Particularly, this may be the world's first report about in situ and simultaneously measurement of soil CO2/CH4/N2O fluxes at low latitude (between 10° N and 10° S). I would like to give the authors my comments.

1. Important references:

To date, through the "Web of Science", I could not find any publication about continuous

measurement of soil CO2 efflux (Rs) using the automated chambers in the low latitude tropical forests that between 10° N and 10° S. Though two campaign studies in very humid forests (ïĆş3500 mm of annual precipitation) using automated chambers each in northeastern Australia (17° S) (Kiese and ButterbachBahl, 2002) and northeastern Puerto Rico (18° N) (Wood et al., 2013) were conducted only less than 6-month period, they observed similar phenomenon with Rs was higher during the dry season but lower during the wet season. Kiese and ButterbachBahl (2002) also measured N2O flux. Conversely, a 4-year continuous measurement of Rs in a seasonal dry (1,250 mm of annual precipitation) tropical forest in western Thailand (14° N) showed higher Rs in wet season than that of dry season (Hanpattanakit et al., 2015).

2. CO2 flux:

Empirically, also see the above references, CO2 flux is largely controlled by soil moisture (rain events) at tropical forests. However, based on Fig 3, during 4-month experiment (June-September 2016), most of the chambers did not show temporal variation in CO2 flux. Thus, the authors are suggested to add soil moisture (and temperature) data to Fig 3 and provide some discussion about the (lack of) relationships between Rs and soil moisture and temperature.

3. CH4 flux:

Generally speaking, upland forest soil is a CH4 sink, even lowland tropical forest soil. Compared to Rs, however, CH4 flux is more complex and generally has large spatial variation, because the termite activity can emit CH4 thus offset a partial of the soil CH4 sink. I am confused with Table 2, because ten of the sixteen chambers showed CH4 source. Li-Cor soil chamber (8100-104) can be considered to block most activity of the termite, because the chamber base (collar; 7 cm in height) was inserted ∼7 cm into the soil and left another 4 cm above the soil; in addition, the chamber has relative additional big metal base surround the collar. On the other hand, inserted chamber base (collar) into the tropical (clay) soil can (sometimes) cause waterlogging inside the Li-Cor soil

chamber (8100-104), which might convert the CH4 sink to CH4 source. Same with CO2 flux, temporal variations in CH4 fluxes also could not be detected in Fig. 4. Also, megascopically, the chambers did not show the common pattern of temporal variation in CH4 fluxes (Fig 4). Sure, this forest has plentiful precipitation (about 3000 mm) and very low elevation, both of these abiotic factors may cause the site as CH4 source. Thus, the authors are suggested to provide some more discussion about (the lack of) spatio-temporal variation in CH4 flux.

4. Appendix Figure A1:

This figure shows a very general (basic) chamber-problem for measurement of soil GHGs fluxes. Long closure time will cause higher GHGs concentration (if the soil is GHGs source) or lower GHGs concentration (if the soil is GHGs sink) inside the chamber, which will induce underestimation of GHGs flux (saturation effect). Saturation effect is generally positively associated with both flux rate and ratio of the effective chamber volume to the measured soil surface area. Empirically, I believe the 2-mintute closure time is enough for measurement of both CO2 and CH4 flux in tropical forests, even for most temperate and boreal forests. For Li-Cor soil chamber (8100-104), the ratio is (0.0040761/ 0.03178=0.12826 m) = 12.3 cm. However, for many of the custom-made soil chambers, the ratio is generally higher than 12.3 cm, thus this is might be the specific problem (issue) only for Li-Cor soil chamber (8100-104). I suggest the authors feedback this problem to Li-Cor and suggest Li-Cor to draw this problem to their instrument user manual.

5. Also for Appendix Figure A1:

The authors are suggested to re-draw the Appendix Figure A1 indicating different symbols (or color) for each of the four chambers.

6. Closure time:

When compared Table 1 with Table 2, the closure time of 10 minutes for measurement

of N2O flux was enough. Thus, the Table 1 is suggested to be deleted.

7. Additional suggestion 1:

To prove the data quality or measurement precision, the authors are suggested to add a plot showing changes in CO2, CH4 and N2O concentrations in the chambers. Following is a sample plot (Sample Fig).

8. Additional suggestion 2:

As I mentioned in the above, this may be the world's first report about in situ and simultaneously measurement of soil CO2/CH4/N2O fluxes at low latitude (between 10° N and 10° S). I believe this paper will be a potential high citation rate if the authors can give some more discussion about spatio-temporal variation in CO2/CH4/N2O fluxes and their control factors. For example, the coefficient of variation (CV) was used to represent the spatial variation. CV of Rs can be calculated by CV = (SD/(mean Rs)) $\times$100.

9. Useful reference:

(1) Hanpattanakit, P. et al., 2015. Multiple timescale variations and controls of soil respiration in a tropical dry dipterocarp forest, western Thailand. Plant and Soil, 390(1-2): 167-181.

(2) Kiese, R. and ButterbachBahl, K., 2002. N2O and CO2 emissions from three different tropical forest sites in the wet tropics of Queensland, Australia. Soil Biology & Biochemistry, 34(7): 975-987.

(3) Wood, T.E., Detto, M. and Silver, W.L., 2013. Sensitivity of Soil Respiration to Variability in Soil Moisture and Temperature in a Humid Tropical Forest. PLoS One, 8(12): 7.

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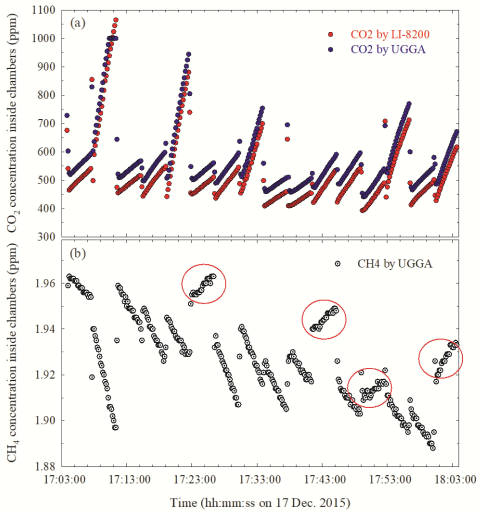

Sample Fig. Changes in CO_2 and CH_4 concentration inside the chambers. This is an *in situ* soil CO_2 and CH_4 flux measurement in a low latitude (<3° N) lowland rainforest using a 16-channel custom-made automated chamber (70×70×50 cm, L×W×H) system coupled with an IRGA CO_2 analyzer (LI-820, Li-Cor Biosciences) and a cavity ring down spectroscopy CO_2/CH_4/H_2O analyzer (UGGA, LGR). Half (eight) of the sixteen chambers were trenched for measurement of heterotrophic respiration. Figure shows one measurement cycle (1 hour) for the sixteen chambers with each sequentially closed for 225 s. CO_2 concentration measured by both LI-820 and UGGA shows linearly increased for all chamber during the 225 s closure time (a). CH_4 concentration (b) shows linearly decreased in all trenched and half (four) of the control chambers but increased in another half of the control chambers (red circles).

Fig. 1. Sample Fig